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sion' engines and for the peculiar form of engine produced by omitting the intermediate cylinder from the latter, thus producing a machine with abnormally high ratio of cylinder-volumes, as successfully employed by Rockwood. A wide range of load was adopted and the result is found to be an efficiency, in the case of the novel form of engine, intermediate between that of the triple-expansion and that of the standard compound, approaching the efficiency of the latter as maximum expansions and minimum loads are approximated. We may be able to give later a fuller abstract of this paper.

Mr. W. S. Keep details a series of experiments upon 'Cast Iron under Impact,' in which he shows some very singular and puzzling phenomena, such as the increase of the strength of the metal by simply smoothing its surface, variation of the resistance and of the elastic limit by such alterations of its superficies, and similar hitherto unsuspected modifications of its molecular characteristics by this method of strain.

Mr. George Richmond offers a study of 'Thermodynamics without the Calculus,' in which he develops in an interesting and peculiarly helpful manner the method of Professor Gibbs in the application of the temperature-entropy system of coordinate, thermodynamic geometry. The paper is presented in compliance with the request of members of the Society in the course of a discussion during the preceding meeting.

Mr. Charles T. Main gives a very unique paper, on the 'Valuation of Textile Manufacturing Property,' which important but greatly neglected department of technical literature has peculiar interest to the capitalist and the economist as well as to the engineer. This study is in great detail, and its writer is an acknowledged expert.

Mr. Fletcher submits an account, given by the inventor, who is still living at a ripe old age, of the invention and introduction

of the Stevens Valve-Gear for steam engines, universally employed for many years past on the 'American river-boat engine.' It is an interesting and valuable contribution to technical history.

Other papers, numbering in all over twenty, are contributed by as many members, each expert in his own department, and affording material for another valuable volume of transactions.

The next meeting will probably be at Niagara Falls.

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PRESIDENT GILMAN ON THE RELATIONS  
OF SCIENCE AND COMMERCE.

At the annual banquet of the Chamber of Commerce in New York, November 23d, the chairman, Mr. Alexander E. Orr, called upon President Gilman, of Johns Hopkins University, to respond to this sentiment, *Commerce the Child of Science and its filial Supporter*. The substance of Mr. Gilman's remarks is indicated in the following report:

Let me give some striking illustrations of the impulse that Commerce has received from Science; but let them all be drawn from present times, at least from days with which many men in this assembly are personally familiar.

Without astronomy there could be no sure navigation of the open sea. The great observatories, with their able masters and their powerful lenses, are revealing to human intelligence the celestial mechanism, and are making every year more accurate the nautical almanacs—those guides to the heavens, so sure and so important that we may almost call them 'The Pilots' Bible.' It is to the science of naval architecture that commerce owes the marvelous improvements which have transformed the packets of the 'Black-ball' line and the Baltimore clippers into the iron steamers of to-day. The size, materials, forms, structure, of sea-going ships, both men-of-war, protectors of

commerce and the great liners of the ocean, are the results of careful study, by able men in quiet hours, devoted to the ascertainment of accurate knowledge.

It is the science of mechanics which has developed the steam engine for the feeble motor, plied by Fulton on the Hudson, into the triple and quadruple expansion engines which now propel these enormous steamers, to and fro, across the ocean, with a regularity almost as sure as the swinging of a pendulum.

Geographical science has studied every portion of the globe and opened to commerce the continents of Africa and Australia, and the islands of Japan and Oceanica, closed to Europeans before the days of Wilkes, Perry, Stanley and other explorers.

It is to hydrography that commerce owes the accurate surveys of coasts, channels and harbors, initiated in this country by the Blunts, those once famous New Yorkers, and those surveys of the ocean depths which made possible the laying of the Atlantic Cable.

Physics has well fulfilled its part by the improvements introduced into the construction of the mariners compass, the propelling screw, the perfection of light houses, the introduction of fog signals, and the ever advancing development of electro-magnetism, most significant, far reaching, revolutionary and serviceable of all modern discoveries.

Meteorology, a branch of physics, grows more accurate every year and is interpreting and foretelling the course of winds and cyclones.

Almost all these advances lie in the field of mathematics.

Cancel these gifts of science. Restore electricity to the excitement of a bit of amber, bring back the quadruple expansion engine to the tea-kettle from which it has been evolved, reduce the nautical almanac to a deliniation of 'the Dipper,' and destroy

the charts on which reefs and shoals are carefully indicated to the rude outlines of even fifty years ago—and where would commerce be?

Now let us change our point of view and see how these obligations have been met. With open-handed munificence, with horns of plenty filled with the products of every clime, Commerce, the child of Science, has been her generous supporter. Rapidly glance at the record.

It was an East Indian merchant

Born in America, in Europe bred,  
In Africa travelled and in Asia wed

made those gifts to the collegiate school in New Haven, which have given renown for almost 200 years to the name of Elihu Yale. The last half century has been prolific in kindred gifts. It was a merchant of Mobile who founded the Sheffield Scientific School in New Haven; a merchant of Boston who gave his name to the Lawrence Scientific School in Cambridge; a merchant of New York who established the John C. Green School of Science in Princeton; a merchant of Brooklyn whose gifts to Cornell University surpassed the founder's; a business man of Philadelphia who founded the Towne School of Science; a merchant of New Orleans whose name is recalled by Tulane University; and a merchant of Baltimore, Johns Hopkins, who divided his fortune between a university and a hospital.

Just so with modern libraries in this country. John Jacob Astor, a merchant of New York, set the example, soon to be followed by Lenox and Tilden. Joshua Bates, a partner of the Barings, rendered a like service to Boston, and William Brown, one of the Brown Brothers, to Liverpool. The museums at Cambridge and New Haven attest the scientific interest of George Peabody, who founded a library in Baltimore. Chittenden, of New York; Pratt, of Baltimore; Newberry, of Chicago, each one a mer-

chant, and a great many more, are the builders of libraries, which Carlyle once called 'the true universities.' When Western learning is needed in Turkey and the Levant, it is a merchant of New York who founded Robert College, near Constantinople, and another merchant, William E. Dodge, and his associates, who established the Syria College of Beirut. When it was a question of Arctic research Henry Grinnell and George Peabody equipped the expedition of Kane and his successors, and when a museum of natural history was required, or a gallery of fine arts, it was from the members of this chamber that support was secured. Thus commerce generously has contributed to the maintenance of learning. Is it not that the pursuit of commerce broadens the mind? To promote among the nations of the earth those exchanges which benefit alike the buyer and the seller enlarges human sympathy. The study of the world's resources, requirements and conditions of prosperity produces wisdom, courage, forethought and generosity.

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*PRIMITIVE MAN IN THE DELAWARE VALLEY.\**

INTRODUCTORY.

A FEW years ago, as a result of extended explorations, conducted by the Bureau of American Ethnology, questions were raised with reference to the soundness of the then existing evidence relating to glacial man in the Eastern States, and the correctness of the conclusions drawn from it. Since that time, until quite recently, investigation has progressed slowly and but little has been brought forward likely to change the status of the case. Now, however, strong claims are being made of the discovery of new and confirmatory evidence of antiquity, and discussion is invited with a view of deter-

mining its merits; but before taking up this phase of the subject it is desirable that the earlier phases of the investigations be passed briefly in review.

The questions raised by me were not those of the age of man in America. I have always taken the view that the race must have occupied this continent for a very long period. Great antiquity is clearly proved by facts derived from other than archæologic or geologic sources. It does not require argument to show that the development of many well differentiated nations and tongues means a prolonged occupation. It does not take argument to demonstrate the proposition that, notwithstanding the potent influence of local environment upon human art and effort, a thousand distinct cultures could not spring up in a day.

The only questions I have ventured to discuss and the only ones that now claim my attention are as to whether the evidence already brought forward to demonstrate the antiquity of man on the Atlantic slope will stand the test of scientific scrutiny. There is a record of man in the valleys and among the hills throughout the entire country. There is an important record in the geological formations of the Delaware valley. Has the key to this record been discovered? Has the true combination been worked out, or are our pioneer investigators struggling through a phase of this particular research corresponding to that encountered by the predecessors of Champollion in the reading of the Egyptian hieroglyphs? The earlier readings at Trenton seem to indicate possibly three distinct peoples and periods of occupation, referred to by some as paleolithic, Eskimo and Indian; but are we sure of more than one and are the others mere figments of the imagination? Time will tell, but this year or the next may not finally decide it.

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\*Read at the Detroit meeting of the American Association for the Advancement of Science.